AN EXPERIMENTAL CONTRIBUTION TO INTESTINAL SURGERY WITH SPECIAL REFERENCE TO THE TREATMENT OF INTESTINAL OBSTRUCTION.[1]

(CONTINUED.)

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5. Colo-Rectostomy.

AMONG the many possibilities in the operative treatment of intestinal obstruction a condition might be met with where the seat of obstruction is located low down in the colon, perhaps in the sigmoid flexure, and where it might be impossible or impracticable to remove the cause of obstruction, and where it becomes necessary to restore the continuity of the intestinal canal by establishing a communication between the permeable portion of the colon and the rectum. Such an anastomosis can be made as in ileo-colostomy by lateral implantation, lateral apposition by perforated approximation plates or by double suturing. For want of time only one experiment was made, and although the animal died of the immediate effects of the operation the local conditions at the site of operation found after death show that colo-rectostomy in selected cases is not only a justifiable and feasible operation, but whenever it can be done, it is always preferable to the formation of an artificial anus. As the operation by lateral apposition requires much less time than lateral implantation, it should be preferred to the latter procedure, and should be done by perforated approximation discs and a few superficial sutures.

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Experiment 90.—Medium-sized cat. Incision through the linea alba; colon cut transversely in the middle third and the distal portion, and the rectum cleared of its contents by injecting a stream of warm water from the cut end downward, a procedure which could only be well accomplished after forcible dilatation of the sphincter ani muscles. The distal end was closed in the usual manner. The rectum was drawn upward and an incision made into its anterior wall large enough to correspond with the lumen of the colon, Into this opening the proximal end of the colon was implanted by two rows of sutures. During the latter part of the operation, which lasted over an hour, the animal was seized by convulsions which continued for several hours, and finally subsided under the administration of whiskey given hypodermatically. The symptoms of shock, however, continued and death occurred 36 hours after operation. Numerous omental adhesions; closed end of bowel congested; peritoneal surfaces adherent; colon and rectum at point of implantation adherent.

REMARKS.—In cases where the obstruction is located some distance from the rectum where it would be impossible to approximate the permeable portion of the colon with the rectum, the entire colon must be excluded and the continuity of the intestinal canal restored by ileo-colostomy or ileo-rectostomy. In all cases of intestinal anastomosis where the communication is made in the lower portion of the colon or the rectum, the sphincters of the anus should be rendered temporarily incompetent by stretching for the purpose of guarding against overdistention of this part of the bowel during the time required for the healing process between the united intestines.

ADHESION EXPERIMENTS.

In works on abdominal surgery we invariably meet with the assertion that serous surfaces brought into apposition by suturing unite after a few hours. Isolated experiments and the results of post-mortem examinations have given rise to the general belief that serous surfaces so united will become firmly adherent in a very short time; but the question concerning the exact time for adhesion to take place, and for the definitive healing to be complete, can only be determined by experiments made for this special purpose. The following experiments were made with a view of ascertaining the exact time which is requisite for adhesions and definitive healing between approximated serous surfaces to take place, and likewise to study the effects of local conditions which would hasten or retard these processes. It is quite important to make a distinction between the terms "adhesion" and "healing." Adhesion precedes the process of definitive healing,but implies simply the presence of an adhesive or cement substance between the serous surfaces, which mechanically agglutinates the parts, while definitive healing includes all the processes which take place during cicatrization. In intestinal surgery this distinction has an important practical bearing, as perforation may take place as long as the serous surfaces are simply held together by adhesions, while such an occurrence is beyond the reach of all possibilities after the approximated surfaces have become united by living organized tissue. Adhesions between serous surfaces take place by the exudation of plastic lymph, which acts the part of a cement material; while on the other hand the process of definitive healing is initiated by cell-proliferation from the preexisting endothelial and connective tissue cells, and the formation of a network of new blood vessels springing from each of the coaptated granulating surfaces. The processes are the same as we observe within blood vessels during cicatrization after ligature. In suturing an intestinal wound, or in making a circular enterorrhaphy, it has always heretofore been deemed necessary not to injure the peritoneum unnecessarily, for fear that such injuries would result deleteriously by interfering with the prompt union between the sutured surfaces. It is a well known fact in surgery that approximation of intact serous surfaces does not result in the formation of adhesions. When the surgeon desires to secure union between serous surfaces he resorts to mechanical or chemical irritation for the purpose of inducing a circumscribed plastic peritonitis, which invariably results in adhesions and the obliteration of the serous space. Reasoning from this analogy, I was induced to study the effects of traumatic and chemical irritation in hastening adhesions and cicatrization between apposed serous surfaces. In most of these experiments the serous surfaces in the different operations were held in contact by perforated approximation plates, and in case artificial means were resorted to, to expedite the healing process, the fact is mentioned, and the result of such modification noted. The animals operated on were all dogs.

TIME SIX HOURS.

Experiment 91.—The ileum was divided near its middle, and both ends closed by invagination and the continued suture. Ileo-ileostomy was made at two points making two openings of communication. No suturing. Parts kept in apposition by perforated decalcified bone plates. To compare the effect of traumatic irritation of the peritoneum in the reparative process with the intact serous surface, the peritoneal surfaces at one point of operation designated as the upper were scarified with the point of a needle over an area corresponding to the size of the bone discs, the scratches being made sufficiently deep to penetrate the entire thickness of the peritoneum. The scarifications were made in a longitudinal and transverse direction mapping out the serous surfaces into small squares. Only slight oozing followed this procedure. The serous surfaces between the plates, (No 1.) where no scarification was made were found slightly adherent by a scanty deposit of plastic lymph. At No. 2, where scarification had been done, the amount of plastic lymph was greater and stained by blood and the adhesions much firmer.

TIME TWELVE HOURS.

Experiment 92.—In this experiment the bowel was not interrupted by division, but two adjacent coils of the ileum were united by making an ileo-ileostomy by perforated decalcified bone plates, plates holding the parts perfectly in apposition: a slight tumefaction of the intestinal walls has made the coaptation more secure Coaptated serous surfaces very vascular, covered with a thin layer of plastic lymph which has agglutinated the folds of the intestine brought in contact.

Experiment 93.—Bowel not divided, but two adjoining loops of the ileum united by making a double ileo-ileostomy by perforated approximation discs, the two communicating openings about six inches apart. At one point of operation designated as No. 2, serous surfaces freely scarified. At both points the adhesions were perfect throughout, but where scarification was made they were notably firmer.

Experiment 94.—In this experiment a gastro-enterostomy and an ileo-ileostomy were made at the same time and on the same animal. In both operations the parts were coaptated by perforated decalcified bone plates. Scarification of peritoneal surfaces at both places. The adhesions between the anterior surface of the stomach and upper portion of jejunum were uniform throughout, over the whole surface, kept in contact by the plates. There was no leakage on distending the stomach and intestine forcibly by water. The adhesions between the folds of the ileum at point of approximation were, if anything, firmer than between stomach and jejunum. The decalcified bone plate in the interior of the stomach was softened more than those in the intestine.

TIME EIGHTEEN HOURS.

Experiment 95.—Gastro-enterostomy by perforated decalcified bone plates: communication made between stomach and upper portion of jejunum: no scarification. Agglutination quite firm, so that forcible distention of stomach and bowel causes no leakage. New opening sufficiently large to admit middle finger and apparently lined throughout by mucous membrane. Plate in stomach very much softened and on the verge of becoming detached. On forcibly separating the adhesions the serous surfaces are found to be cemented together by a thin layer of plastic lymph, and after scraping this away they appear vascular, rough, as though completely deprived of the endothelial covering.

TIME TWENTY-FOUR HOURS.

Experiment 96.—Triple ileo-ileostomy without division of the bowel; the operations were numbered 1, 2, 3, respectively. Coaptation by approximation discs of decalcified bone. Communicating openings about six inches apart. In No. 1 no scarification. No. 2 scarification of one loop only. No. 3, scarification of both serous surfaces. After 24 hours the result was as follows:

1. Lymph scanty; adhesions not very firm.
2. Lymph more plentiful; adhesions firmer.
3. Lymph more abundant than in No. 2, and mixed with a fine stratum of coagulated blood; adhesions also firmer. The adhesions increase in firmness in the order 1, 2, 3.

Experiment 97.—Double gastro-enterostomy by perforated decalcified bone plates. The communicating openings, one near the pyloric, and the other near cardiac extremity of the stomach, were made between the anterior surface of the stomach, and the upper portion of the jejunum. In operation No. 1, near the pylorus the intact serous surfaces were brought in contact, while in the second operation both the stomach and bowel were scarified. At the post-mortem, it was found that the adhesions at both places were of sufficient firmness to prevent leakage under pressure. In No. 2 adhesions firmer and the inflammatory infiltration more marked than in No. 1. Plates in stomach much softened, but remain in situ. Openings lined throughout by mucous membrane and sufficiently large to admit the index finger.

Experiment 98.—Ileo-colostomy by lateral apposition and fixation by perforated approximation discs. Lower portion of ileum united with the ascending colon. No scarification; bowels lightly agglutinated throughout, by a very thin layer of plastic lymph; adhesions, however, can be easily separated, and where this is done the peritoneal surface appears denuded of endothelial cells, and very vascular with new vessels along the outer margin of the surface of approximation.

Time Forty-eight Hours.

Experiment 99.—Double gastro-enterostomy. The communicating openings were between the anterior surface of the stomach and the duodenum, and the posterior surface of the stomach and the upper portion of the jejunum. In the posterior operation the intact serous surfaces were brought in contact, while in the anterior the peritoneal surfaces of the stomach and duodenum were scarified. In both operations perforated decalcified bone plates were used. Adhesions between posterior surface of stomach and bowel uniform throughout, but easily broken down; the peritoneal surfaces injected and apparently deprived of their endothelial covering. The anterior operation has resulted in the formation of firm adhesions, the products of exudation and tissue proliferation being supplied with new vessels, the circumscribed plastic peritonitis being much more advanced than at the site of the posterior operation.

Experiment 100.—Double ileo-colostomy by perforated approximation plates. The anastomosis between the lower portion of the ileum and the colon just above the cæcum was made without scarification, while in the second operation about six inches higher up in the colon and ileum both serous surfaces were freely scarified. Omentum adherent at point of operation. Plates swollen, softened and pliable, but still efficient in maintaining coaptation and fixation. Adhesions at both places quite firm, but more so in the upper portion where scarification had been done.

Experiment 101.—Ileo-colostomy by approximation discs. The ileum was divided a few inches above the ileo-cæcal region and both ends closed by invagination, and three stitches of the continued suture. An anastomosis was made between the proximal end and the ascending colon by lateral apposition. No scarification. Intestines agglutinated at point of operation, but the adhesions gave away when the bowel was forcibly distended under hydrant pressure.

7. CHEMICAL IRRITATION OF SEROUS SURFACES.

In these experiments it was aimed to study the effect of chemical irritation of the peritoneum in the reparative process after intestinal operations. Iodine has been used for a long time in producing plastic inflammation of serous surfaces for the purpose of obliterating serous cavities, consequently this substance was used in the first experiments. To study the effects of the diffuse application of tincture of iron to the intact peritoneal cavity the following experiments were made.

8. INJECTION OF CHEMICAL IRRITANTS INTO THE PERITONEAL CAVITY.

Experiment 102.—Medium-sized dog. The needle of a hypodermic syringe was thoroughly disinfected, and a drachm of the tincture of iodine injected into the peritoneal cavity. Immediately after the injection the animal evinced great pain, which, however, appeared to subside after a short time, and subsequently no unfavorable symptoms were observed. Three days after the injection the urine was examined and showed the presence of iodine. Dog killed nine days after the injection. Circumscribed plastic peritonitis over a space four inches square, corresponding to the point where the puncture was made. At this place the omentum was much thickened, very vascular and adherent to the parietal peritoneum and the adjoining folds of the intestines.

Experiment 103.—Medium-sized dog. A fluid drachm of the tincture of muriate of iron was thrown into the peritoneal cavity by means of a well-disinfected hypodermic syringe. The pain immediately after the injection was intense, and the animal appeared to be very ill two days after the injection, and died with well marked symptoms of peritonitis on the sixth day. Diffuse plastic peritonitis was found to be the cause of death. The omentum was adherent everywhere, and the intestines were matted together by numerous adhesions. The abdominal cavity contained a considerable quantity of serous fluid.

REMARKS.—Both experiments prove that when tincture of iodine and tincture of iron are brought in contact with the peritoneum a plastic inflammation ensues, and it was reasonable to expect that if either of these substances could be applied to the serous surfaces which it was intended to unite, the reparative process would be hastened.

Experiment 104.—Triple ileo-ileostomy by perforated decalcified bone plates. Three internal fistulæ were made between the adjacent loops of the ileum about six inches apart. In operation No. 1 approximation of intact serous surfaces: in operation No. 2 the serous surfaces were painted with tincture of iron over an area corresponding to the size of the plates. In operation No. 3, the serous surfaces over the same extent were brushed with pure tincture of iodine. The animal was killed 48 hours after operation, and the following conditions were noted: No general peritonitis. All the plates firmly in place coaptating the serous surfaces accurately, the swelling of the tunics of the bowel only serving to enhance their efficiency. At No. 1 adhesions quite firm, flexion of bowel and marked injection of serous surfaces. At No. 2 no adhesions between serous surfaces. The peritoneal surfaces to which the tincture of iron had been applied appeared stained, almost black, and at some points the serous coat was destroyed. At No. 3 peritoneal surfaces stained dark brown; adhesions firm, and an abundance of plastic lymph even beyond the margin of the plates.

Experiment 105.—Double ileo-ileostomy by approximation plates and omental grafting. Operation No. 1, approximation of ileum to ileum by perforated decalcified bone plates, serous surfaces intact. Operation No. 2, similar operation six inches higher up uniting the same loops, but painting the serous surfaces with pure tincture of iodine. Operation 3. Cut off a piece of omentum 2 inches wide and sufficiently long to encircle the entire bowel. After scarifying the bowel, and the omental graft on one side, the scarified surfaces were brought in contact, and the graft fixed in its place by two fine catgut sutures passed through the mesentery and both ends of the graft. Animal killed 48 hours after operation. All plates firmly in place. At No. 1, adhesions firm. At No. 2, dark-brown discoloration of surface to which the iodine had been applied, agglutination over the whole surface. Under hydrostatic pressure the adhesions first gave way between the two plates where the iodine had been applied, showing conclusively that chemical irritation of serous surfaces does not hasten the adhesive process, while it may, and probably does, expedite the definitive healing. At No. 3, omental graft firmly adherent to the entire circumference of the bowel and beginning vascularization of the graft around its margins.

REMARKS.—In all of these experiments the post mortem examinations showed no evidences of diffuse peritonitis. In most of the cases the inflammatory process was limited to the portion of the bowel interposed between the plates. Without exception the adhesions formed were firmest and the definitive healing was initiated first where scarification was performed, results which clearly demonstrate the fact that the reparative process between serous surfaces which it is intended to unite is hastened by traumatic irritation. Traumatic irritation by scarification of the peritoneal surface with the point of an aseptic needle, is the most potent means to provoke a circumscribed plastic peritonitis, and is followed within a few hours by a copious exudation of plastic lymph, which like a cement substance, mechanically agglutinates the coaptated serous surfaces. The same measure by destroying the continuity of the non-vascular layer of the peritoneum brings at once in contact the vascular network of both sides of the bowel, and opens up a direct route for the new vessels, an important element in the rapid healing of the visceral wounds. Chemical irritants by destroying the endothelial layer of the peritoneum rather retard, than favor, early adhesion and union between the coaptated bowels, and should therefore not be resorted to in intestinal surgery with a view to hasten the reparative process.

[TO BE CONCLUDED.]